

45. (New Claim) The liquid crystal display device as defined in claim 40,
wherein the refractive index anisotropy $\Delta n(550)$ is specified to be not less
than 0.065 and not more than 0.115.

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46. (New Claim) The liquid crystal display device as defined in claim 45,
wherein the refractive index anisotropy $\Delta n(550)$ is specified to be not less
than 0.070 and not more than 0.095.

47. (New Claim) The liquid crystal display device as defined in claim 40,
wherein $(n_a - n_b) \times d$, i.e., the product of the difference between the
principal refractive indices n_a and n_b multiplied by the thickness d of the
phase difference plate, is specified to be in a range from 80 nm to 250
nm.

REMARKS

This application as amended previously included Claims 1-30. Claims 1 and 15 now have been amended so as to clarify Applicants' intent that both transparent-type and reflection-type liquid crystal display devices are deemed to fall within the scope of the presently claimed invention. Claims 31-47 also now have been added for the purpose of more clearly and distinctly setting forth the subject matter that Applicants regard as the invention. No claims have been cancelled by the foregoing Amendment. Accordingly, Claims 1-47 will remain under active prosecution in this application upon the entry of the foregoing Amendment.

In the currently outstanding Official Action, the Examiner has:

1. Indicated that the newly cited reference (Wu) does not apply to Claims 1-4 (presumably meaning 14) and 29. Further, Applicants assume that the Examiner has now agreed with their position concerning the inappropriate nature of the previous rejection of the claims of this application under 35 USC 102(e). **Accordingly, it is Applicants' understanding that the only outstanding ground of rejection applicable to Claims 1-14 and 29 is the judicially created obviousness-type double patenting rejection referred to in paragraph 5 of the presently outstanding Official Action. In the event that this understanding is in any way incorrect, it is respectfully requested that the Examiner contact the undersigned by telephone (collect) immediately.**
2. Objected to the Title of the Invention as amended in the previous amendment in this application as still being not descriptive, and required Applicants to provide yet another new Title of the Invention that is clearly indicative of the invention to which the claims are directed.
3. Indicated that he presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made, and reminded Applicants of their duty to inform him in the event that the facts may be otherwise.

4. Rejected Claims 15-28 and 30 under 35 USC 103(a) as being unpatentable over the Haas reference (US Patent 5,375,006) in view of the Wu article and the Nishimura et al article.
5. Rejected unspecified claims (presumably claims 15-28 and 30) under 35 USC 103(a) as being unpatentable over the Ito reference (US Patent 5,583,679) in view of the Wu article and the Nishimura et al article.
6. Rejected Claims 15-28 and 30 under 35 USC 103(a) as being unpatentable over the Kamada et al reference in view of the Wu article and the Nishimura article.
7. Indicated that Claims 1-30 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over the claims of co-pending U.S. Patent Application Serial No. 08/996,956.
8. Indicated the remaining prior art made of record is considered pertinent to Applicants' disclosure, but is not relied upon in the rejection of any of Applicants' pending claims.

With regard to item 1, Applicants will defer their comments to the discussion of item 7 set forth in detail hereinbelow.

With respect to item 2, Applicants now have deleted the present Title of the Invention in its entirety, and have substituted a new Title of the Invention therefor. It is believed that the new Title of the Invention proposed hereinabove will be acceptable to the Examiner. If, however, this is not the case, it is respectfully requested that the Examiner telephone the undersigned in order that an acceptable Title of the Invention may be agreed upon expeditiously.

With regard to item 3, Applicants hereby confirm that the subject matter of the various claims was commonly owned at the time that any inventions covered therein were made.

With regard to items 4-6 concerning the substance of claims 15-28 and 30, the Examiner has asserted that the present invention is unpatentable over Haas in view of Wu and Nishimura et al. Similarly, the Examiner has asserted the unpatentability of claims 15-28 and 30 regarding the combinations of the Ito reference or the Kamada et al. reference with the Wu and Nishimura articles, respectively.

Preliminarily, it is Applicants' position that Examiner's arguments are not convincing because they each rely upon hindsight to justify the rejections under 35 U.S.C. 103(a). More particularly, conspicuously in each of the grounds of rejection stated in the currently outstanding Official Action under 35 USC 103(a) it is stated that: "As the primary reference yields a very high viewing angle, **it appears very likely that the elimination of the reversion of color is inherent** to the matching of dispersion characteristics of the two films, combined with the selection of a compensator that enables a wide viewing angle." This is a totally self-serving and conclusory statement by the Examiner. It is respectfully submitted that it falls far short of the definitive disclosure, teaching or suggestion of the present invention within the four corners of the prior art cited that is required to justify the rejection of the present claims. Applicants believe that this point alone justifies the allowance of the present claims over the prior art here of record.

In addition, it is to be understood that a liquid crystal display device develops undesirable coloring of display images due to variations in the lengths of the optical paths through the phase difference plate and liquid crystal layer when the display is viewed from an oblique angle. This is also the case due to color going out of balance because of irregularities in the apparent optical axes (slow axis and fast axis) of the phase difference plate and liquid crystal layer when the display is viewed from an oblique angle. The present invention relates to a technology that solves these phenomena by means of adjustment of the wavelength dispersion of liquid crystal molecules, even in those cases wherein the liquid crystal molecules are moved by voltage application. It is believed that the present invention is distinct over each of the cited references, and any combination thereof, because in the present invention the wavelength dispersion of the liquid crystal does not coincide with that of the phase difference plate.

More specifically, in order to solve the problem of the display image appearing different depending upon the viewing angle from which it is viewed, the Haas reference discloses a twisted nematic liquid crystal display device as shown in Figure 1 thereof. This device essentially comprises: a compensation plate 11 made of an uniaxial birefringent optical medium; a liquid crystal; and two mutually crossing polarizers 3 and 4 (see ABSTRACT and col. 1, BACKGROUND...). "ZU-3347" available from MERCK is used in the Haas reference as the liquid crystal in the liquid crystal display device (see, col. 3, lines 10-18). This liquid crystal material appears to be different from the "liquid crystal material of which the refractive index anisotropy is specified to vary with wavelengths of rays of light within a range that allows no viewing-angle dependent coloration to occur to an image displayed on the liquid crystal display element" which is used in the present invention.

Further, unlike the phase difference plate of the present invention, the compensation plates of the Haas reference do not provide any definition with respect to the relationship among their principal refractive indices n_a , n_b , and n_c . Still further, Haas exhibits a high transmittance of blue (short wavelength) light and a low transmittance of red (long wavelength) light in comparison to TN as shown, for example, in Figure 17. This causes a color imbalance that makes display images appear bluish.

In contrast, it is a purpose of the present invention to not only to eliminate color reversion, but also to prevent color imbalance in the front direction even when the display is viewed from an oblique angle. The result is that since the color does not go out of balance when viewed from oblique angles, the transmittance drops on both blue and red.

The Nishimura et al. article disclose a liquid crystal polymer film which improves optical properties (contrast ratio and optical response) of STN-LCD's. The liquid crystal polymer film, as shown in Figure 2, includes a liquid crystal polymer placed between a film substrate and an overcoat. This allows control over the twist angle, retardation, and wavelength dependence of birefringence. However, unlike the phase difference plate of the present invention, the Nishimura et al liquid crystal polymer film is not defined by any specification of the relationship among its principal refractive indices n_a , n_b , and n_c .

It also is to be recognized that Nishimura et al. relates to STN-LCD's, and that its purpose is to improve the color compensation and contrast ratio of display images when viewed in the front direction. These are phenomena that are unique to STN-LCD's. The present invention, on the other hand, keeps the color in good balance in the front direction when the display is viewed from an oblique angle.

The Ito reference attempts to improve viewing angle properties. To accomplish this, Ito discloses an optical compensation sheet that is an optical anisotropic layer formed on a transparent support. The molecules of this layer possess discotic structure units therein. Also the principal refractive indices of the optical compensation sheet are defined to satisfy the relationship: $n_1 \leq n_3 \leq n_2$ (see, col. 20, lines 3-4) Further, as shown in Figure 4 of the Ito reference, the principal refractive index n_2 is parallel to the sheet surface, and the principal refractive indices n_1 and n_3 incline to the normal of the sheet surface.

Similarly, the Kamada et al.reference discloses that in order to improve viewing angle properties an optical compensation sheet should be provided in which a layer made of discotic liquid crystal is formed on a transparent support. In this optical compensation sheet, the principal refractive indices n_1 , n_2 , n_3 satisfy the relation: $n_1 \leq n_2 \leq n_3$ (see, col. 13, line 64). Further, as shown in Figure 4 of Kamada et al, the principal refractive index n_2 is parallel to the sheet surface, and the principal refractive indices n_1 and n_3 incline to the normal of the sheet surface.

In contrast, in the phase difference plate of the present invention as set forth in claims 15 and 30, the principal refractive indices n_a , n_b , and n_c satisfy the relation: $n_a = n_c > n_b$. In addition, the principal refractive indices n_a and n_c are parallel to the phase difference plate surface, and the principal refractive index n_b is parallel to the normal to the surface. Hence, the present invention clearly differs from the Kamada et al. reference in the arrangement of the phase difference plate.

In addition, it is to be recognized that neither the Ito reference nor the Kamada et al. reference specify the respective optical properties of the liquid crystal material used in combination with the optical compensation sheets disclosed therein, whereas the present invention does. As will appear more fully below, the Examiner's citation of the Wu reference fails to cure this deficiency in his rejections under 35 USC 103(a).

Moreover, it will be seen that the present application discloses a first liquid crystal display device comprising a phase difference plate whose refractive index ellipsoid inclines satisfying $n_a < n_b < n_c$ (claim 1), and also a second liquid crystal display device comprising a phase difference plate whose refractive index ellipsoid does not incline satisfying $n_a = n_c > n_b$ (claim 15). This is not the case in the cited references. Specifically, the phase difference plates disclosed in both the Ito reference and the Kamada et al. reference have totally opposite optical properties from the first phase difference plate of the present invention. Those phase difference plates also differ from the second phase difference plate of the present invention in that the refractive index ellipsoid inclines.

Consequently, it will be understood that the present invention shares some commonality with the Ito reference and Kamada et al. reference to the extent that they all attempt to improve viewing angle properties. Each of these structures, however, produces a different degree of color variation depending on the viewing angle, and the disclosure of neither of the references is adequate to teach, disclose or suggest the present invention.

To correct the last mentioned deficiency in the other cited references, the Examiner now has introduced the Wu reference as providing the teachings/suggestions missing from the other cited references. The Wu reference discloses a biaxial compensation film which is a polyimide film fabricated, by spin coating, of polycarbonate that is developed to extend the ranges of the viewing angle and the wavelength. Again, however, unlike the phase difference plate of the present invention, the compensation film of the Wu reference is not defined in terms of the relationship among its principal refractive indices n_a , n_b , and n_c . Further, although the Wu reference discloses ZLI-2857 available from MERCK being used as the liquid crystal material, this liquid crystal material also does not have optical properties of the liquid crystal material used in the present invention.

In addition, the Wu reference also discloses the liquid crystal and the phase difference plate being stacked so that their wavelength dispersions overlap. In contrast, the present invention discloses the liquid crystal being adjusted in its wavelength dispersion to keep the color in good balance in the front direction when the display is viewed from an oblique angle. This is clearly not the same as the liquid crystal and the phase difference plate being stacked so that their wavelength dispersions overlap.

Those skilled in the art, therefore, would clearly recognize that to produce similar results in the LCD of the Wu reference as are provided in the present invention, (1) the refractive index ellipsoid of the phase difference plate must exhibit totally opposite properties from the refractive index ellipsoid of the liquid crystal phase, (2) the retardation value (Re value) of the phase difference plate must coincide with $d \Delta n$ of the liquid crystal phase, and (3) the thickness df of the phase difference plate must be equal to the thickness d of the liquid crystal phase. Of course, even if these conclusions were to be drawn by such an individual, they would be improper hindsight reasoning based upon the disclosure of the present application. Further, under any circumstances, it would be recognized in the art that such control is extremely difficult in view of the current level of technology, and far from practical.

Accordingly, Applicants respectfully submit that the currently outstanding rejections of claims 15-28 and 30 under 35 USC 103(a) are factually in error and legally inappropriate. Therefore, a decision withdrawing the currently outstanding rejections under 35 USC 103(a) and allowing the claims of this application in response to this communication is respectfully requested.

With regard to item 7, Applicants respectfully remain in disagreement with the Examiner's provisional rejection of Claims 1-30 under the judicially created doctrine of obviousness-type double patenting as being obvious over the claims presently allowed and set to issue in Application No. 08/996,956. The bases for this disagreement with the Examiner's provisional rejection are set forth in the Remarks section of Applicants' response to the previous Official Action in this Application and need not be repeated here.

It is Applicants' present understanding that the Examiner has agreed with their argument that US Patent Application Serial No. 08/996,956 cannot constitute prior art to the present application under 35 USC 102(e) in the present circumstances. Further, while the Examiner has quoted authority to the effect that a statutory double patenting rejection under 35 USC 101 cannot be overcome by a terminal disclaimer, the Examiner's actual double patenting rejection is based upon the judicially created doctrine of obviousness-type double patenting which can be overcome by a terminal disclaimer. (See, 37 CFR 1.321c)

Therefore, without prejudice to its assertion that US Patent Application No. 08/996,956 (which has the same United States filing date as the present application) is not appropriate to a consideration of the patentability of the present application, Applicants are filing with this Amendment a terminal disclaimer for the purposes of removing any possible basis for the Examiner's obviousness-type double patenting rejection in this application. Hence, it is believed that the only outstanding impediment to the allowance of claims 1-14 and 29 of the present application is rendered moot by the attached terminal disclaimer. A decision allowing Claims 1-14 and 29 in response to this communication consequently is respectfully requested.

Finally, with regard to item 8, Applicants have reviewed the art cited, but not applied by the Examiner. Applicants agree with the Examiner's determination that none of this art adversely affects the patentability of any of the presently pending claims in this application. Further comment in these Remarks regarding the non-applied art cited by the Examiner, therefore, is not believed to be either required, or appropriate.

In view of the foregoing Amendment and Remarks, it is believed that all of the claims that will be present in this application upon the entry of the foregoing Amendment are in condition for allowance. Reconsideration and allowance of this application in response to this communication, therefore, is respectfully requested.

Applicants believe that additional fees are not required in connection with the consideration of this response to the currently outstanding Official Action. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge and/or credit Deposit Account No. **04-1105**, as necessary, for the correct payment of all fees which may be due in connection with the filing and consideration of this communication.

Respectfully submitted,

Date: January 26, 2001

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